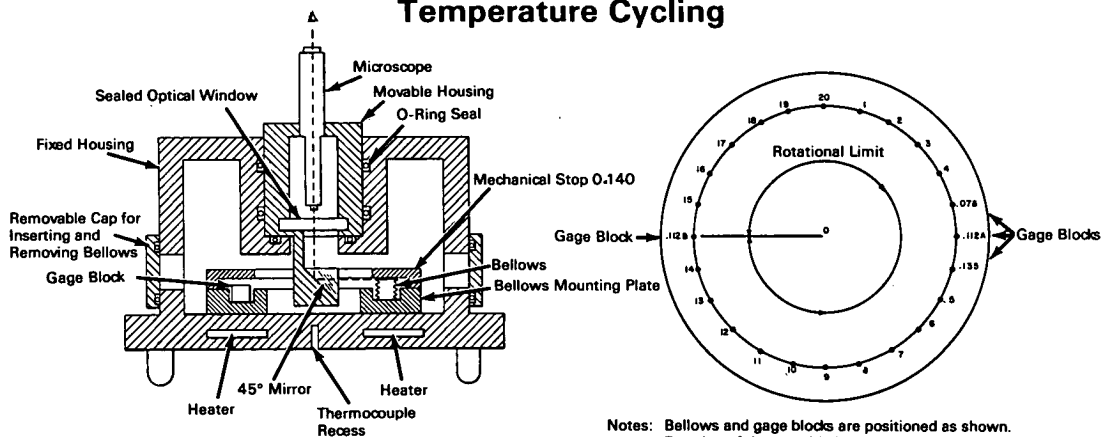


# NASA TECH BRIEF



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## Fixture Tests Bellows Reliability Through Repetitive Pressure/ Temperature Cycling



Notes: Bellows and gage blocks are positioned as shown. Rotation of the movable housing is as indicated.

### The problem:

In precision accelerometers used in inertial systems, four small bellows are used in each instrument and are subjected to repetitive pressure/temperature cycles as they provide volume change compensation through fluctuating thermal gradients. To assure reliable accelerometers, it is necessary to establish the operating pressure/temperature capability and life expectancy of the bellows involved.

### The solution:

A test fixture designed to explore the reliability of bellows by establishing their ability to withstand repetitive over-stress pressure cycling at elevated temperatures.

### How it's done:

The fixture includes a circular bellows mounting plate having 24 drilled holes about its perimeter at 15 degree intervals. Four precision gage blocks and 20 bellows (for test) are positioned in the mounting plate holes. A mechanical stop attached to the mounting plate prevents bellows extension beyond 0.140 inch

from normal. Heaters and a thermocouple are recessed in the base of a fixed housing containing the bellows mounting plate. Attached to the fixed housing is a movable housing containing a microscope, a rack and pinion (not shown) for focusing the microscope, a sealed optical window, and a mirror and a light source (not shown). A control console provides pressure cycling to each bellows under test by application of measured levels of pressure and vacuum in accordance with predetermined cyclic timing. The control console also supplies power for the light source and for the heaters which are operated on and off in accordance with the test profile. Pressure and vacuum gages plus a temperature gage are also mounted on the console for test monitoring.

In operation, the movable housing is rotated about its axis toward each bellows in turn, as specific conditions of pressure, vacuum, and temperature are introduced. The light source is behind the bellows and measurements of bellows performance under test are taken through the optical path indicated by the dotted line. The microscope barrel is a micrometer

(continued overleaf)

type divided in 0.00005-inch increments and the fixed vertical reticle is aligned with one of the gage block centerlines by rotation of the movable housing. By a vernier, the reticle is then adjusted to the gage block height and the vernier reading recorded. The movable housing is rotated to align the microscope reticle with the first bellows to be tested and the vernier is adjusted to bring the reticle to the bellows height. This vernier reading is recorded and the test is begun. As each predetermined condition of pressure, vacuum, and temperature is imposed on the test bellows, the microscope vernier is adjusted to align the reticle with the bellows height and the readings recorded. Comparison of the vernier readings relating to bellows height with the vernier reading of test block height permit evaluation of the bellows through repetitive pressure/temperature cycling.

**Notes:**

1. This tool could be used effectively in quality control and reliability programs.
2. Inquiries concerning this invention may be directed to:

Technology Utilization Officer  
Manned Spacecraft Center  
Houston, Texas 77058  
Reference: B67-10111

**Patent status:**

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: Carl Levinson  
of Sperry Gyroscope Company  
under contract to  
Manned Spacecraft Center  
(MSC-1176)